

# **Executing Your Measurement and Analysis Plans**

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***Software Process Improvement (SPI) Project***

# Purpose and Objectives

- **Purpose:** To help you understand how to execute a measurement and analysis plan
- **Objective - After this session you should understand:**
  - The process steps for implementing your measurement and analysis plan
  - The three key components to execution: analysis, impact, and corrective action
  - Approaches to measurement and analysis of the the five measurement areas required by NPR 7150.2

# The Measurement Process\* Steps for Planning

The steps for planning measurement and analysis activities were addressed last week:

1. Establish measurement objectives
2. Identify the essential measurement analyses that support these objectives
3. Specify the measures to be collected
4. Specify your data collection and storage procedure
5. Specify your analysis procedure

\*<http://software.gsfc.nasa.gov/AssetsApproved/PA3.4.doc>

# The Measurement Process\* Steps for Collecting and Analyzing Data

**This week we'll cover the steps for executing the measurement and analysis plan:**

- 6. Collect measurement data**
- 7. Analyze collected data**
- 8. Store collected data and analysis results**
- 9. Communicate results to stakeholders**

**\* <http://software.gsfc.nasa.gov/AssetsApproved/PA3.4.doc>**

# M&A Process Step 6: Collecting Data

- One of the steps last week included development of a Data Collection and Storage Procedure
- Follow that procedure, which defines
  - Who is responsible for collecting and providing measures
  - How frequently to collect the measurements
- Collect the data
  - Responsible person sets up or installs tools  
(SPI tools have **user's guides** describing setup, data definitions, updating and reporting)
  - Team Lead collects initial milestone data

# M&A Process Step 7: Analyze Collected Data

- **Do a quick analysis when data is collected**
  - For example, biweekly collection of progress data
  - Probe more if there is a potential problem,
  - If there is a serious issue, *don't wait* to address it
- **Do a full analysis according to the schedule defined in your Analysis and Reporting Procedure**
  - Schedule analysis to occur at least monthly, but frequency can vary with project phase
  - If there is a serious issue, *don't wait* to address it
- **Document analysis results**
  - Per your Analysis and Reporting Procedure, normally monthly in the Branch Status Review (BSR)
  - When unscheduled analysis leads to corrective action

# M&A Process Step 8: Store Collected Data and Analysis

- **Follow Collection and Storage Procedure**
  - **Person responsible for collecting data should check it for completeness and accuracy**
- **Put data where your Data Management List (DML) says it should go**
  - **Follow a file naming convention that includes dates**
  - **Store successive versions, normally monthly**

# M&A Process Step 9: Communicate Results

- **Report the results of measurement analyses to relevant stakeholders on a timely basis**
- **Assist stakeholders in understanding the results of analysis**
  - **Ensure that results are interpreted correctly by all concerned**
- **Report regularly**
  - **At Branch Status Reviews**
  - **At milestone reviews**
  - **Whenever you need to communicate an issue to stakeholders between scheduled reviews**



# SPI Tools to Assist You in Analyzing Measures

- **Requirements Metrics Tool**
  - Requirements Growth
  - Requirements Volatility
  - Delivered Functionality by Build
- **Problem Report Tool**
  - Software Quality
- **Measurement Summary Tool**
  - Project Characteristics
  - Milestone Data
  - Size Estimates
  - Notes
- **Staffing tool**
  - Staffing Data
  - Process Effort
- **Schedule tool**
  - Overall Progress
- **Point Counting Tool**
  - Detailed Progress
- **Risk Tool**
- **Action Item Tool**

\* <http://software.gsfc.nasa.gov/tools.cfm>

# 3 Key Concepts to Analyzing Measures

## ■ Analysis

- Look to see if behavior indicated by data is within expectations.
- If not, *examine what could be causing anomalies*
- Cross check with other data
- Explain what data is saying, good or bad
- Separate real trends from noise

## ■ Impact

- *Quantify likely effects* on cost, schedule, quality, risk
- “No impact” is a legitimate answer
- Take credit when things are going well

## ■ Corrective Action

- Describe *how you will address issues*
- “Monitor risk” is a legitimate answer
- “None needed” is a legitimate answer

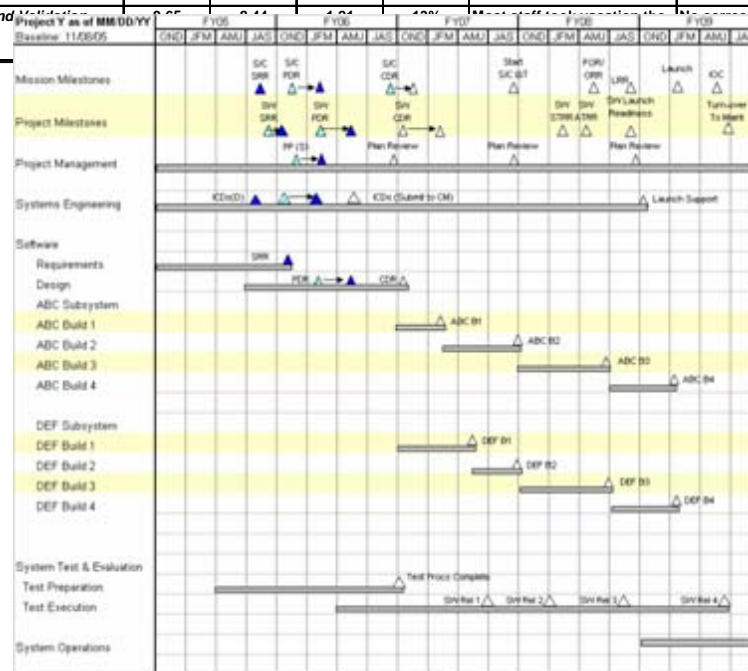
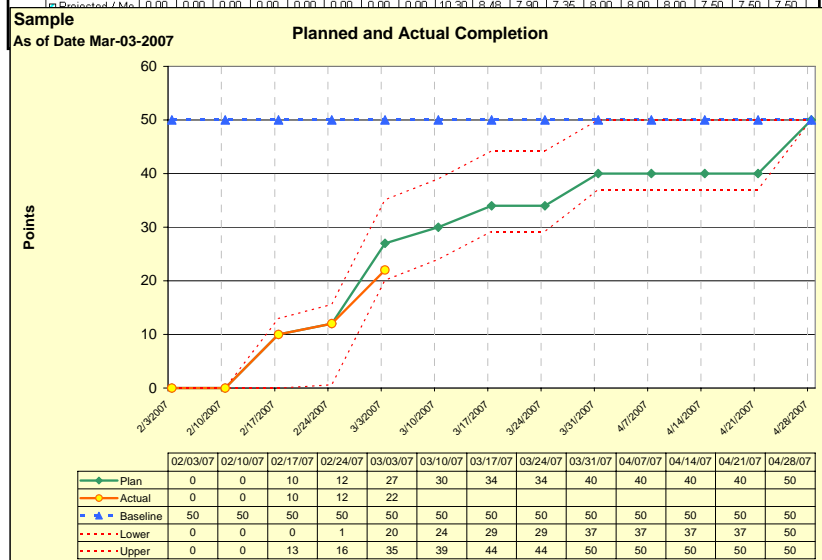
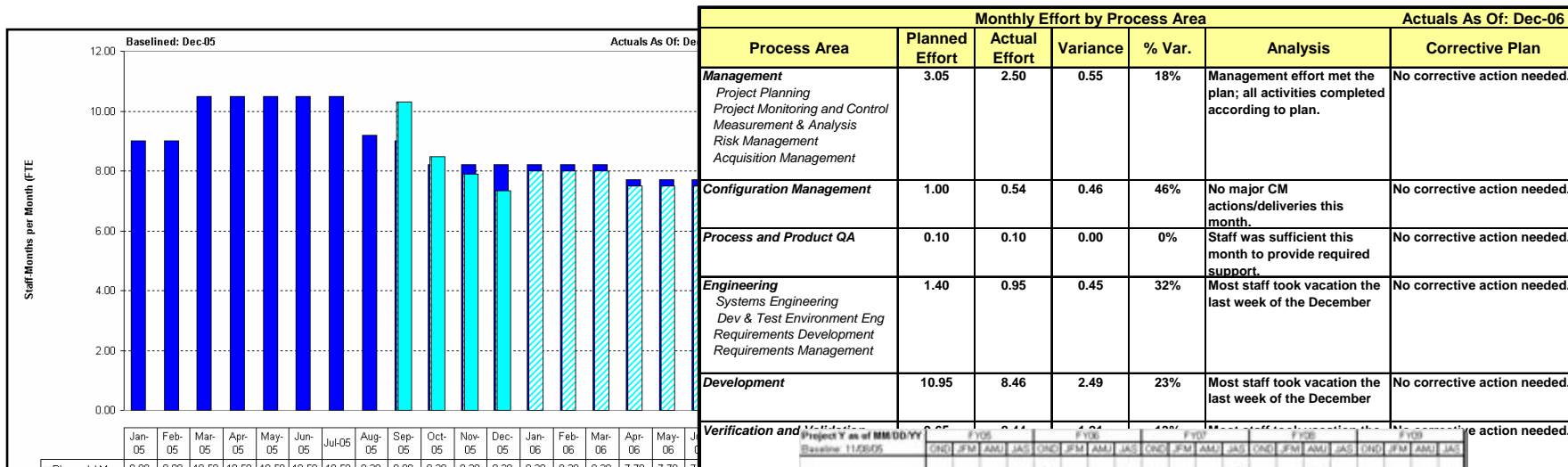
# Review: NPR 7150.2 Measurement Requirements for Class B Projects

- **Required measurement areas for all software projects**
  - **Software Progress Tracking**
  - **Software Functionality**
  - **Software Quality**
  - **Software Requirements Volatility**
  - **Software Characteristics**
- **Additional NPR requirements for Class A and B projects**
  - **Process monitoring as required for CMMI Capability Level 2**
  - **Data specified for Software Inspection/Peer Review Report**
  - **Data collected “on a CSCI basis”**

# Analyzing Software Progress Measures

- **Analyze your software progress**
  - Determine if activities are being accomplished at the rate planned
  - Determine if resources are being used at the rate planned
  - Assess why the variance is occurring
    - Do you have the resources you planned for?
    - Have you used more resources than planned to get the work done?
    - Are your tools, skill level, training, complexity of work, etc., as planned
- **Data to check during the analysis**
  - The schedule (with point counts) and the staffing for consistency with each other and the plan
- **Consider the Potential Impact**
  - If one or more activities are behind schedule or over cost will it affect other areas ... or the ultimate delivery?
  - Is variance temporary, ongoing, or getting worse?
- **Develop a Corrective Action Plan**
  - Look for ways to improve productivity (process, training, tools, equipment, or skill level)
  - Consider adjusting resources ... adding more or reallocating the ones you have

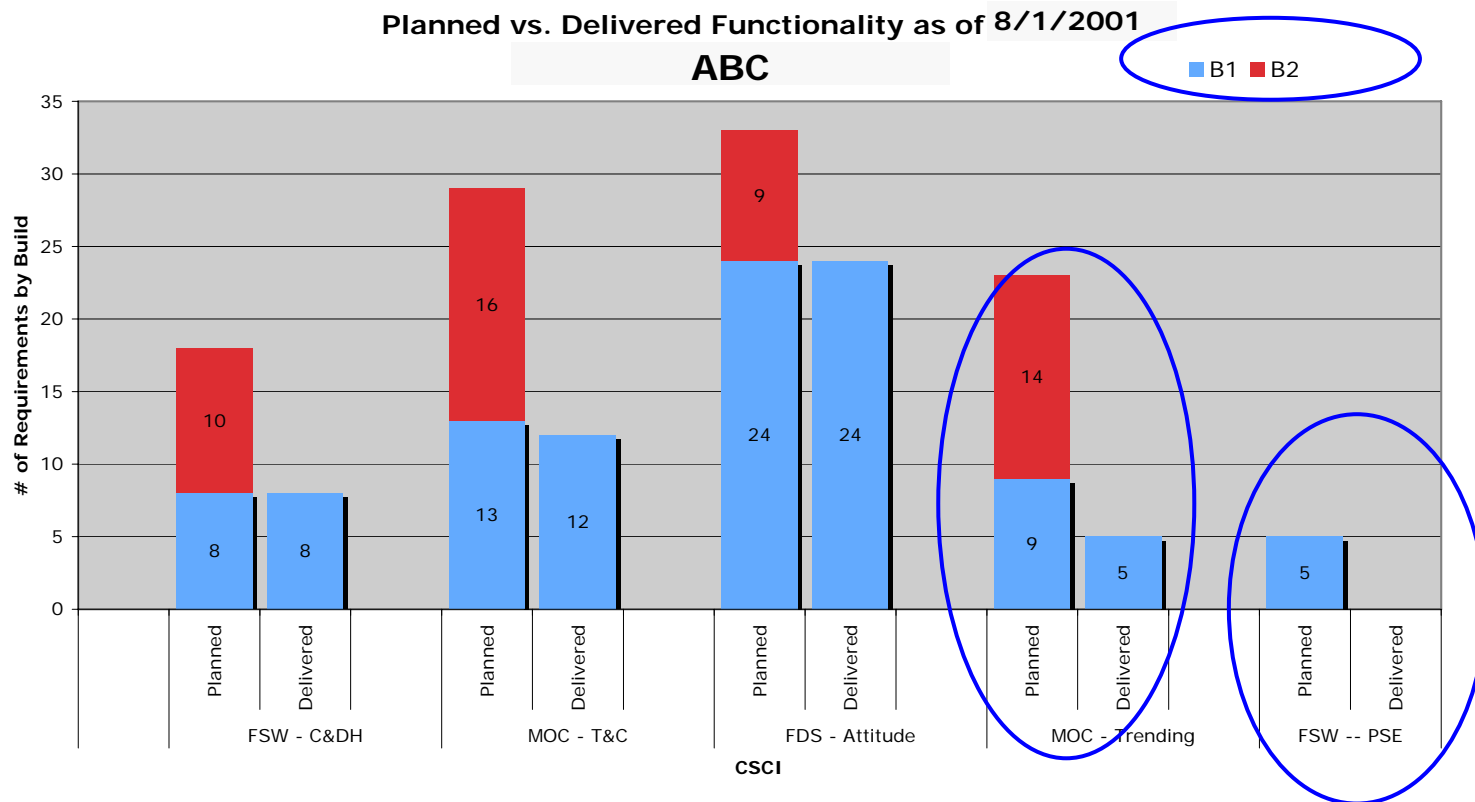
# Software Progress Tracking Examples



# Analyzing Software Functionality Measures

- **Analyze your software functionality**
  - If delivering more than planned, take credit
  - If delivering less than planned, figure out why
    - Build was delivered early because stakeholder needed it
    - Build was more complex than expected
    - One or more requirements were TBD or pending clarification
- **Data to check during the analysis**
  - Point counts from the Point Counting Tool (if behind in one place are you ahead somewhere else?)
  - Scheduled delivery dates from a schedule tool
  - Requirement-to-build mapping, and requirement test status
- **Consider the Potential Impact**
  - Will release (or overall) cost or schedule be affected?
  - Will release (or overall) quality from the Customer viewpoint be affected?
- **Develop a Corrective Action Plan**
  - Consider what you need to add the planned functionality
  - Optionally, adjust the build plan to move functionality to other builds

# Functionality By Build Example



**Analysis:** Build 1 for the trending system is missing capabilities due to requirements TBDs. PSE Build 1 is scheduled for delivery on 9/1/01.

**Impact:** None -- developers worked on Build 2 capabilities for all subsystems while awaiting resolution of TBDs

**Corrective Action:** Monitor to assure remaining TBD is resolved

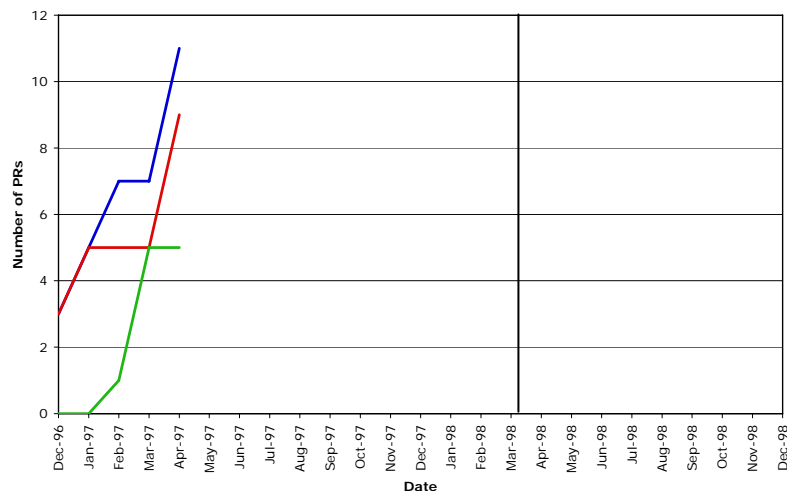
# Analyzing Software Quality Measures

- **Analyze software quality through errors, defects, and problem reports (PRs)**
  - Current count and severity status show where you stand now and trends show where you're headed
  - Assess the cause of the errors ... inadequate requirement understanding, erroneous design, coding errors, etc.
- **Data to check during the analysis**
  - Where you are in the test phase
  - Peer review defect metrics versus PRs
- **Consider the Potential Impact**
  - Will a growing number of open PRs affect the schedule or quality?
  - Will you have to bring on more people to fix problems?
- **Develop a Corrective Action Plan**
  - Consider improved peer reviews to catch errors earlier
  - Consider training staff or moving in more senior people
  - Are there tools that could help find problems earlier?

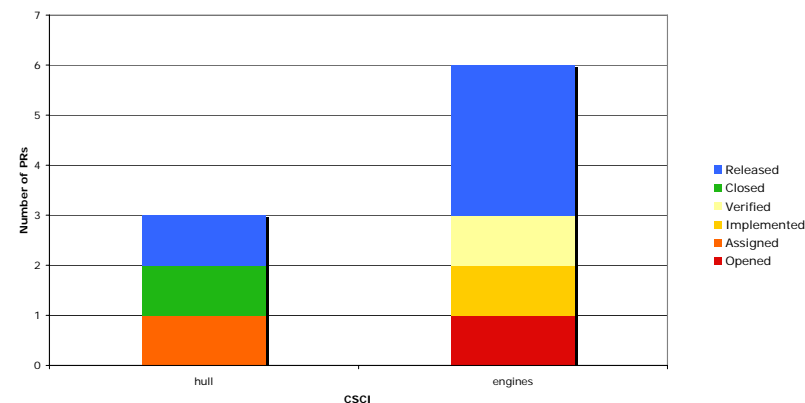


# Problem Report Tool Example

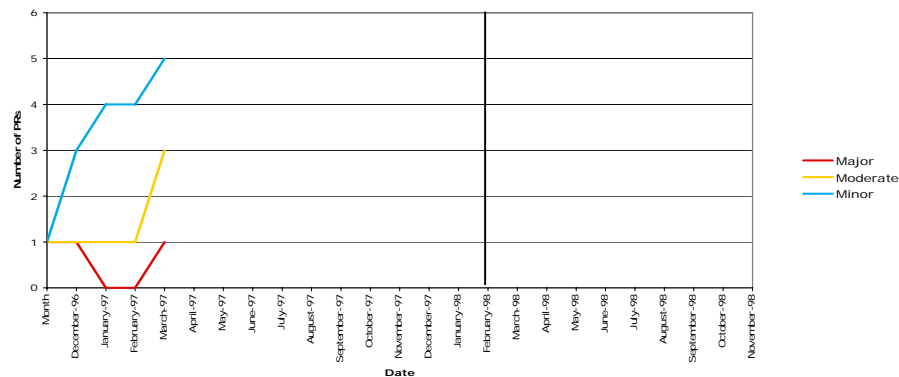
Problem Report Progress  
RMS Titanic



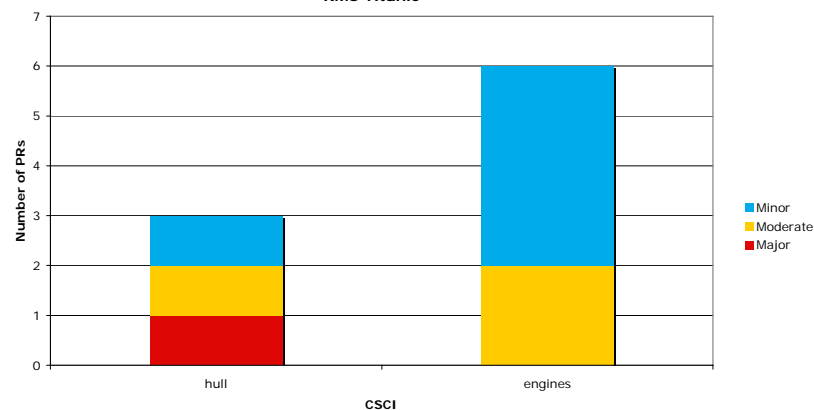
Current Status For Each CSCI  
RMS Titanic



Problem Severity Trends  
RMS Titanic



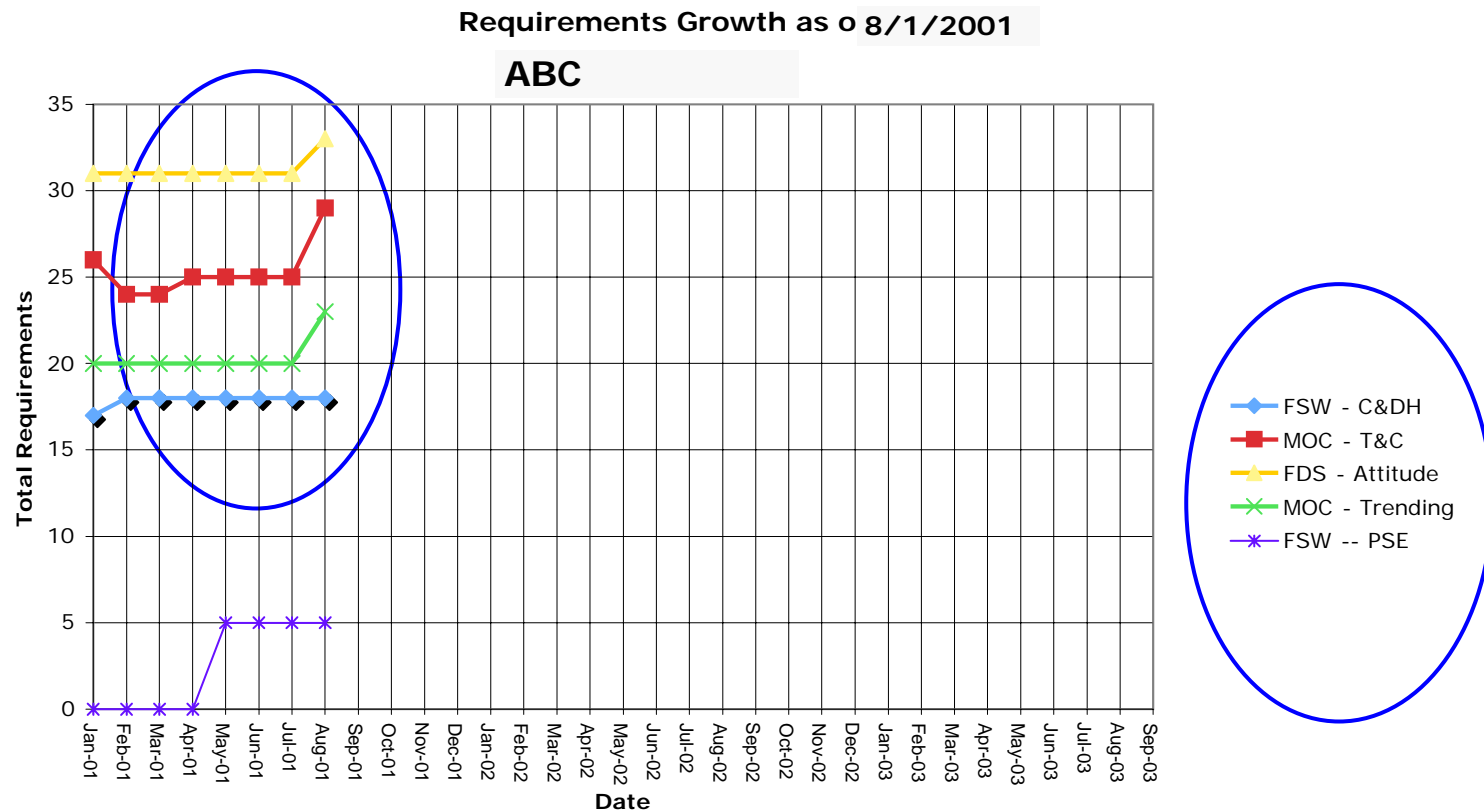
Problem Severity by CSCI  
RMS Titanic



- **Analyze requirement volatility through metrics on growth, uncertainties (TBDs), and change**
  - What metrics are higher than expected
  - Why are they higher?
    - Unstable “mission” environment
    - Incomplete requirements at the start
    - Lack of team understanding of requirements
    - The “bell and whistle” syndrome
- **Data to check during the analysis**
  - Planned and actual effort for “Engineering” process
  - Problem report data from the Problem Report Tool
- **Consider the Potential Impact**
  - Expanding requirements base may increase system complexity (interfaces, etc.)
  - Changing requirements may mean extra work or rework
  - “TBDs” mean uncertainty in what you really have to do ... and how long it will take

- **Develop a Corrective Action Plan**
  - Try to improve requirement analysis and documentation
  - Implement a peer review process for requirements
  - Tighten CM / CCB control
  - Reschedule to implement more stable subsystems first
  - For changes late in the life cycle, consider rearranging test schedules
  - Adjust your plans to correct any requirement inconsistencies with existing plans
    - Add staff
    - Extend schedule,
    - Postpone requirements

# Requirements Growth Example



**Analysis:** Requirements growth is in line with pre-CDR growth for previous projects

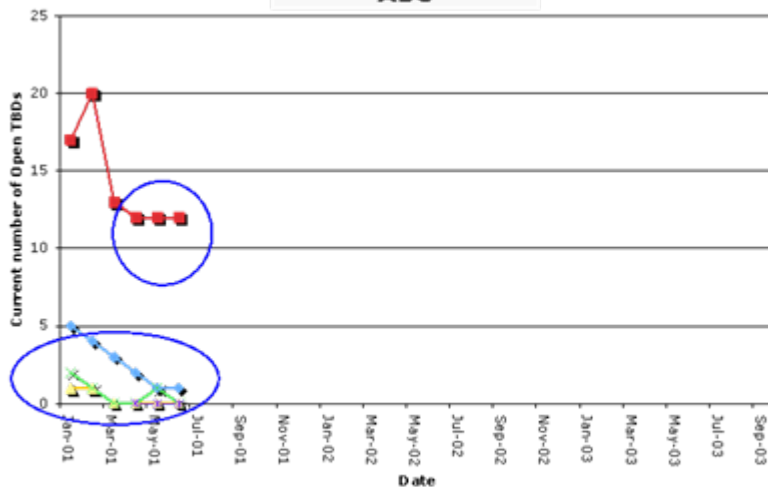
**Impact:** None

**Corrective Action:** None

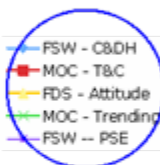
# Requirements “TBD” Example: Before and After Corrective action

TBD Requirements as of 6/1/2001

ABC



**Analysis:** TBDs for MOC Telemetry & Command system are not being resolved due to understaffing  
**Impact:** As this subsystem routes data from all other subsystems, T & C development can't proceed until these TBDs are resolved. We estimate a one-month delay to do this.  
**Corrective Action:** T & C expert Gilbert Arenas will be added to the team temporarily to resolve these TBDs. This is expected to be a full time assignment for one month.



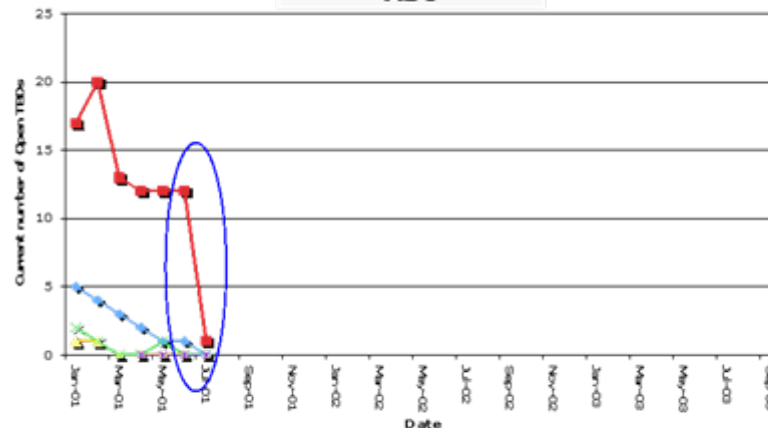
**Analysis:** All significant TBDs have been resolved, the outstanding TBD involves safe hold data rates

**Impact:** None -- the expectation is that the data rate will be similar to previous missions, and the system architecture can handle this

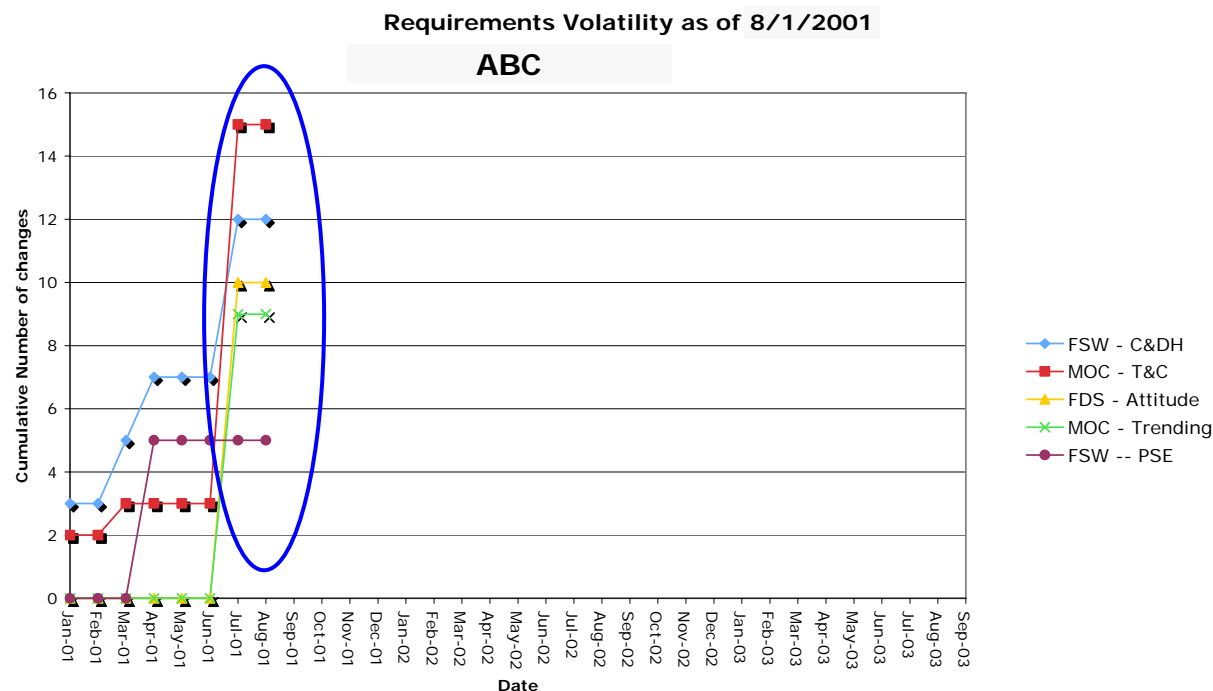
**Corrective Action:** Monitor to assure remaining TBD is resolved

TBD Requirements as of 8/1/2001

ABC



# Requirements Change Example After “TBD” Corrective Action



**Analysis:** This is a higher than usual number of changes; however it is due to extra effort to resolve TBDs  
**Impact:** None  
**Corrective Action:** None

# Collecting Software Characteristics Data at Milestones

- For projects already in progress
  - Reconstruct data from documentation, review materials, status reports ...
    - ... don't make it up, but find what you can
- Organizational measurement approach
  - Data is kept anonymous
  - SPI will use data for cross-project analysis of
    - **Estimation accuracy**: to determine how GSFC projects estimate cost and schedule
    - **Productivity**: to assess actual productivity rates and improve cost estimates
    - **Error rates, requirements changes**: to provide a basis of comparison when analyzing data

# Milestone Data (from Measurement Summary Tool)

Project Name									
Contact Name									
Contact e-mail									
Software Domain									
CSCI Name	CSCI Type	CSCI Class	OTS	Development	Development	Target HW	Target OS	Target OS	
Milestone:		Start	SRR	PDR	CDR	Start Test	End Test	Maint.	
Basis of Estimate Provided (Y/N)									
Estimate of total effort									

Project Characteristics

Planned Milestone Dates								
System Requirements Review								
Preliminary Design Review								
Critical Design Review								
Start of Customer Testing								
Milestone:		Start	SRR	PDR	CDR	Start Test	End Test	Maint.
Actual Milestone Date								
Actual Effort to Milestone (FTEs)		0.0						
Requirements Counts as of Date								

Estimates & Plans

Actuals Sheet

Number of req	CSCI Name	Size Units	Start	SRR	PDR	CDR	Test Start	Test End	Maint
Number of requirem			Estimate of	Estimate of	Estimate of	Estimate of	Estimate of	Actual Size	Actual Size
Cumulative requirements			total size	total size	total size	total size	total size		
Cumulative Defects									
Critical defe									
Moderate defe									
Minor defe									

CSCI Size Data Sheet



# Acquisition Considerations

- Acquisition measurement responsibilities depend on division of work
  - Example 1 - contractor is doing all technical work
    - Contractor manages its work with full set of metrics
    - Government person monitors contractor analysis
    - Government person collects and analyzes status on government acquisition and monitoring activities
  - Example 2 - government is providing requirements and running acceptance tests
    - Contractor manages its work with full set of metrics
    - Government person monitors contractor analysis
    - Government person collects and analyzes government process effort, adding requirements engineering and test effort
    - Government person collects and analyzes metrics on functionality and requirements volatility
- Collect Measurement Summary Data from contractor

- Metrics generated by project-specific tools (e.g., DOORS, Bugzilla,...)
- Metrics in SPI tools\* including, **Staffing Tool, Schedule Tool, Point Counting Tool, Requirements Metrics Tool, Problem Report Tool, Measurement Summary Tool**
- **Monthly Analyses**
  - In spreadsheets for each analysis period
  - In BSR packages

\* <http://software.gsfc.nasa.gov/tools.cfm>

## *When planning for measurement ...*

- **Measurement is a good management practice**
  - Helps uncover unpleasant surprises early (when you might stand a chance of recovery)
- **Select measures linked to your project's goals**
  - SPI measures address most common objectives
  - SPI tools help collect, store, analyze and report with respect to these objectives (And meet NPR 7150.2 and CMMI requirements, too!)
- **Define measurement procedures as part of planning**
  - Makes responsibilities clear for who provides, collects, stores, analyzes and presents data.
- **SPI assets are your starting point, not your final plan**

## *When executing measurement activities ...*

- Use procedures written during planning phase
  - Data Collection and Storage Procedure
  - Analysis and Reporting Procedure
- Collect, analyze and report at appropriate rates
  - May collect more frequently than analyzed
  - May analyze more frequently than reported
- Analyze and report data to highlight problems
  - If there is no variance, assess whether there should be
  - Assess the cause and quantify impact of variances
  - Trust the data ... a trend doesn't change unless something else changes
    - Some people don't believe the data and go with their "gut" feel ... and get into trouble
  - Implement corrective actions to address issues the data uncovers

# *Questions?*

- **BSR – Branch Status Review**
- **CCB – Configuration Control Board**
- **CDR – Critical Design Review**
- **CM – Configuration Management**
- **CMMI – Capability Maturity Model Integrated**
- **CSCI – Computer Software Configuration Item**
- **DML – Data Management List**
- **NPR – NASA Procedural Requirement**
- **PR – Problem Report**
- **SPI – Software Process Improvement**
- **TBD – To Be Determined**